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BIOLOGICAL SURVEY OF

WILSON RESERVOIR - SALINE RIVER, KANSAS

AUGUST 1970

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INTRODUCTION

As requested by the U. S. Army Corps of Engineers through the Missouri Basin Region of the Water Quality Office, Environmental Protection Agency, a biological survey of Wilson Reservoir, Kansas, and adjacent reaches of the Saline River were conducted by the Division of Field Investigations, Cincinnati, Ohio. Objectives of the study were to assess biological conditions in the reservoir and to determine the effects of the impoundment on the aquatic life downstream from the reservoir. Previous studies were conducted annually (1,2,3,4,5) from 1964 to 1968

Personnel from the Division of Field Investigations collected and analyzed samples of bottom animals and phytoplankton and measured light penetration and phytoplankton productivity. Physical and chemical data were collected and analyzed by personnel from the Kansas State Department of Health. Assistance in the field study was provided by the Army Corps of Engineers.

Wilson Reservoir, located near Sylvan Grove, Kansas (Figure 1), has a storage capacity of 779,000 acre-feet; 531,000 acre-feet are for flood control and 248,000 acre-feet

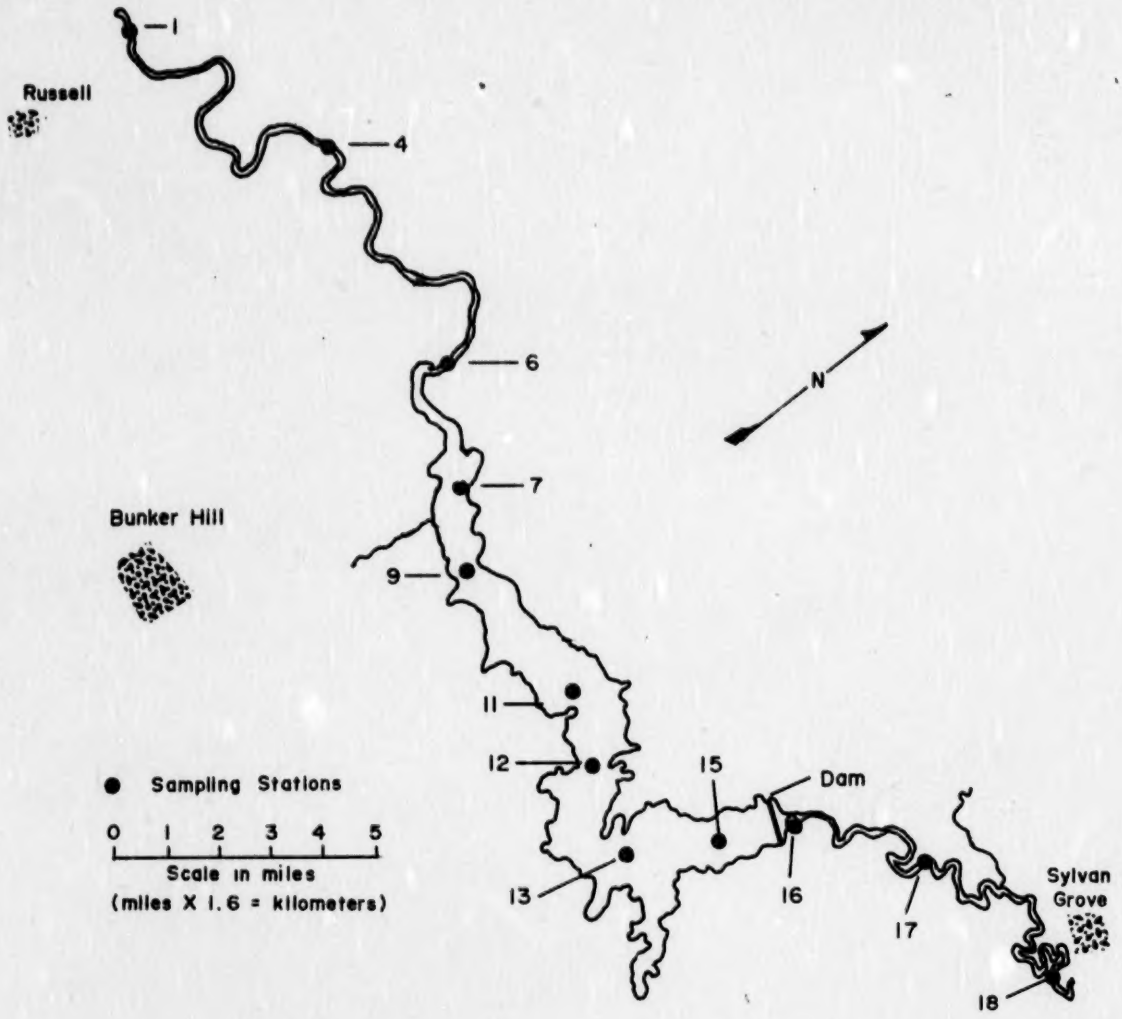

FIGURE 1. LOCATION OF SAMPLING STATIONS ON THE SALINE RIVER AND WILSON RESERVOIR.

are for multipurpose use and sedimentation reserve. The surface area at multipurpose level is 9000 acres. At maximum flood control level an additional 11,000 acres of land are temporarily inundated. Wilson Reservoir has 100 miles of shoreline and drains 1,117 square miles of the Saline River basin. Water flowing into Wilson Reservoir contains large concentrations of dissolved materials, especially during low flow periods. This is due to the leaching of sandstone formations by ground water.

PHYSICAL AND CHEMICAL FINDINGS

As noted in earlier studies, Wilson Reservoir continued to improve the water quality of the Saline River by diluting the more saline water from inflowing streams. Water flowing into the reservoir (station 4) contained high concentrations of dissolved materials such as chloride, sulfate, calcium, magnesium, and sodium (Table 1). Total solids concentration was 5710 mg/l and specific conductance was 14,700 micro mhos/cm. Water discharged from the reservoir (station 16) contained considerably smaller amounts of these materials (Table 1). Specific conductance of the discharged waters was 2700 micromhos/cm and total solids were 1660 mg/l.

Temperature profiles indicated that thermal stratification in early August was not well defined in the downstream reaches of the reservoir (stations 15 and 18) and was nonexistent in the upstream reaches (Table 1).

The concentration of dissolved oxygen in Wilson Reservoir was greater than 5 mg/l except in the near-bottom waters where the lowest concentrations were as low as 2.5 mg/l (Table 1). Water in the Saline River downstream from the dam was supersaturated with oxygen (10.2-10.4 mg/l) as a

result of the photosynthetic oxygen production of attached and suspended algae in this reach of the river.

Bottom Animals

The condition of the bottom animal community in the Saline River upstream from Wilson Reservoir is dependent on the concentration of dissolved solids[4]. High salt concentrations, especially during periods of low flow, limit the variety and density of bottom animals. In August, the bottom animal community at station 1, a riffle area, was indicative of a clean water environment. The variety of animals (19 kinds) was the largest collected at this location since sampling was initiated in 1964. The density of bottom animals, though, had been four times greater in 1965. The predominant animals in this reach of the river were mayfly nymphs and caddis fly larvae (Table 2).

Downstream at station 4, a pool area, the variety of bottom animals (seven kinds) was much smaller than at station 1. Concentrations of dissolved solids at this station were the highest measured in the study area. The bottom habitat (primarily course sand and fine gravel) was not favorable for bottom associated animals. Because of this, quantitative samples of bottom animals were collected from silt deposits, a more favorable habitat for these organisms. Bottom animal density in these deposits was 101 animals/sq. ft.

The poor bottom substrate, the lack of current, and the high concentrations of dissolved solids at this location prevented the establishment of a greater variety of bottom animals.

The diversity of the bottom animal community in Wilson Reservoir had increased since 1968. Midge larvae were the predominant bottom animals. Burrowing mayflies, desirable fish-food organisms, had become more widespread since 1968 when they were found only in the downstream reaches of the reservoir. Sludgeworms, associated with organically enriched bottom sediments, were not excessively abundant although they were the predominant bottom animal in the downstream reaches (stations 13 and 15). Bottom animals had become more uniformly distributed in the main part of the reservoir (stations 9 to 15) and the average animal density had increased from 17/sq. ft. to 35/sq. ft. since 1968. The increase in the variety and density of bottom-associated animals and the more widespread occurence of burrowing mayflies indicated an improvement in the bottom animal community in Wilson Reservoir in the last two years.

The bottom animal community downstream from Wilson Reservoir (station 17) has also improved since 1968. Stabilized flow conditions, better water quality (reduced concentrations of dissolved solids), and time for

colonization by aquatic animals has resulted in almost a two-fold increase in animal diversity (8 kinds in 1968; 15 kinds in 1970). Bottom animal diversity in this reach has increased steadily since the reservoir was impounded in 1964. Most of the increase in diversity resulted from colonization by mayflies and caddis flies, both clean-water associated animals. Improvement was also indicated by a 40 percent reduction in the sludgeworm population since 1968.

At station 18, animal diversity was lower than in 1968 (18 kinds--1968; 13 kinds--1970), but organic enrichment of the substrate in this reach of the Saline River, as indicated by the density of the sludgeworm population has been eliminated. Only one sludgeworm/sq. ft. was found in this riffle area in 1970 compared to 120/sq. ft. in 1968. The reduction in the enrichment of the environment was also reflected by the nine-fold decrease in bottom animal density since 1968.

Phytoplankton

Phytoplankton standing crop in the Saline River upstream from the Reservoir was small--0.1-0.2 ppm wet algal volume (Table 3).

Light penetration of the waters in Wilson Reservoir permitted photosynthetic activity by suspended algae to a depth of 25 feet near the dam (station 15) and two feet

in the upstream reaches (station 7) (Table 3). The increased light penetration in the downstream reaches resulted from the settling of suspended materials as water passed through the reservoir.

In early August estimates of primary productivity (the rate of carbon assimilation by algae during photosynthesis) were 812 mg C/m^3/day (487 mg C/m^2/day) in the upstream reaches of the reservoir and 194 mg C/m^3/day (1480 mg C/m^2/day) in the downstream reach near the dam. The rate of production per cubic meter of water in the downstream reach of Wilson Reservoir was 25 percent higher than it was during August of 1968. Also the depth of the euphotic zone had more than doubled permitting algal productivity to occur in deeper waters. As a result, the algal productivity per square meter in the downstream reach of the reservoir had increased from 512 mg C/day in 1968 to 1480 mg C/day in 1970. The larger standing crop of bottom animals in the reservoir was primarily the result of a larger food supply generated by the increase in algal productivity.

Phytoplankton density in the lighted zone in Wilson Reservoir averaged 2.5 ppm wet algal volume in the upstream reaches and decreased to 0.7 ppm in the downstream reaches.

In 1968 green algae and diatoms were the predominant algae. In August 1970 green algae, alone, predominated.

The Saline River downstream from the dam (stations 17 and 18) contained a phytoplankton standing crop that was similar in size to that upstream from the reservoir. Wet algal volume in this reach ranged from 0.1 to 0.4 ppm.

SUMMARY

The bottom animal community in Wilson Reservoir had improved since 1968. The variety and density of bottom animals in the reservoir had increased and the animals were more uniformly distributed. Burrowing mayflies, desirable fish food organisms, had become more widely established. The increase in the density of bottom animals was caused, in part, by a larger food supply resulting from greater algal productivity.

The quality of water in the Saline River continued to be improved by the presence of Wilson Reservoir. Water discharged from the Reservoir contained considerably smaller quantities of dissolved materials than in-flowing water. The better water quality and the stabilized river flow provided by the impoundment had improved the aquatic environment downstream from the reservoir, and permitted the establishment of a greater variety of clean-water-associated animals.

REFERENCES

1. Anon., 1967. Wilson Reservoir, Kansas Biological Survey. Sept. 1967. U. S. Dept. of the Interior, FWPCA. Missouri Basin Region, Kansas City, Mo., Mimeo. 2 pp.

2. Thomas, N. A. 1964. Preimpoundment Biological Survey of Wilson Reservoir - Kansas, August 1964. U. S. Dept. of Health, Education and Welfare, Public Health Service, Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio. Mimeo. 6 pp.

3. _____ 1965. Postimpoundment Biological Survey of Wilson Reservoir--Kansas, August 1965. U. S. Dept. of Health, Education and Welfare, FWPCA. Technical Services Program, Cincinnati, Ohio. Mimeo. 5 pp.

4. _____ 1966. Biological Survey of Wilson Reservoir, Kansas, August 1966. Tech. Advisory and Investigations Activities, FWPCA, U. S. Dept. of the Interior, Cincinnati, Ohio. Mimeo. 6 pp.

5. _____ 1968. Impoundment Biology of Wilson Reservoir, Kansas, Tech. Advisory and Investigations Branch, FWPCA, U. S. Dept. of the Interior, Cincinnati, Ohio, Mimeo. 20 pp.

Table 1

Physical and Chemical Data*

Wilson Reservoir - Saline River, Kansas

August 4, 1970

Station No.	Depth ft.	H2O Temp. °C	Dissolved Oxygen mg/l	Specific Conductance micromhos	pH	PO_4 mg/l	SO_4 mg/l	Cl mg/l	NO_3-N mg/l	Ca mg/l	Mg mg/l	Na mg/l	T.H. $CaCO_3$ mg/l	Alk. MO mg/l	Total Solids mg/l
1	surf.	29.0	6.1	9,100	7.9	0.10	996	2470	0.2	232	102	1760	998	324	5710
4	surf.	29.0	5.8	14,700	7.7	0.16	1358	4420	0.2	262	173	3070	1364	448	9580
6	surf.	28.5	6.2	5,400	8.2	0.13	490	1100	0.2	139	51	770	556	192	2680
9	surf.	27.3	6.0	2,900	8.2	0.10	360	710	0.2	120	36	490	448	156	1796
	5	27.3	5.9												
	10	27.0	5.8	2,900											
	15	27.0	5.0												
	20	27.0	2.5	3,100											
11	surf.	27.0	6.7	2,800	8.2	0.12	340	650	0.2	112	36	450	428	152	1676
	5	26.8	6.8												
	10	26.6	6.8	2,800											
	15	26.6	6.7												
	20	26.5	6.5												
	25	26.5	6.0	2,800											
12	surf.	25.5	7.1	2,700	8.2	0.10	330	630	0.2	114	37	433	436	156	1624
	5	25.8	6.9												
	10	25.8	6.7	2,750											
	15	25.8	6.7												
	20	25.8	6.6	2,700											
	25	25.8	6.6												
	30	25.8	6.5												
	33	25.8	4.2	2,800											
13	surf.	26.0	7.0	2,600	8.3	0.09	330	630	0.2	109	37	439	424	162	1604
	5	25.6	7.0												
	10	25.5	7.0	2,500											
	15	25.2	7.0												
	20	25.2	7.0	2,600											
	25	25.1	6.9												
	30	25.1	6.8	2,600											
	35	25.1	6.7												
	40	25.0	5.8	2,600											
	45	25.5	5.6	2,600											
15	surf.	26.6	7.4	2,800	8.3	0.08	330	630	0.4	114	36	433	432	162	1652
	5	26.5	7.3												
	10	26.1	7.2	2,700											
	15	26.1	7.1												
	20	26.0	7.0	2,800											
	25	26.0	7.0												
	30	26.0	7.0	2,800											
	35	26.0	7.0												
	40	26.0	7.0	2,800											
	45	26.0	6.8												
	50	26.7	5.6	2,800											
	55	26.0	4.8												
	60	26.0	4.6												
	65	26.0	4.1	2,800											
16	surf.	24.5	7.5	2,700	8.2	0.10	335	640	0.7	118	34	450	434	168	1660
17	surf.	32.0	10.2	3,400	8.3	0.10	352	700	0.4	114	31	506	412	162	1780
18	surf.	32.0	10.4	3,400	8.3	0.11	360	720	0.4	114	35	506	428	162	1820

*Collected and analyzed by the Kansas State Department of Health.

Table 2

Bottom Fauna Data

(Organisms per Sq. Ft.)

Wilson Reservoir - Saline River, Kansas

August 3-5, 1970

	Saline River		Wilson Reservoir						Saline River	
	1	4	6	9	11	12	13	15	17	18
Mayflies										
Caenis	5	2	*	-	-	-	-	-	*	-
Paraleptophlebia	29	-	-	-	-	-	-	-	-	-
Trichorythodes	1	-	-	-	-	-	-	-	*	-
Isonychia	*	-	-	-	-	-	-	-	*	*
Hexagenia	-	-	-	1	2	2	-	1	*	*
Baetis	-	-	-	-	-	-	-	-	2	2
Caddis Flies										
Cheumatopsyche	19	-	-	-	-	-	-	-	4	110
Psychomia	-	-	*	1	-	-	-	-	-	-
Hydropsyche	-	-	-	-	-	-	-	-	*	34
Leptocerus	-	-	-	-	-	-	-	-	*	-
Dobsonflies										
Corydalus	*	-	-	-	-	-	-	-	-	-
Beetles										
Neoelmis	1	-	-	-	-	-	-	-	-	1
Hydrobius	*	-	-	-	-	-	-	-	-	-
Berosus	-	-	*	-	-	-	-	-	-	-
Midges										
Chironomus	1	71	3	7	2	-	-	-	51	6
Pseudochironomus	1	5	-	-	-	-	-	-	90	-
Spaniotoma	1	-	-	-	-	-	1	3	-	*
Tanytarsus	1	-	3	25	-	-	9	-	-	-
Tanypus	-	12	-	-	17	5	-	6	-	-
Coelotanypus	-	-	-	2	-	1	-	-	-	-
Pentaneura	-	-	-	-	2	1	2	-	2	-
Cryptochironomus	-	-	-	-	-	-	1	2	9	*
Polypedilum	-	-	-	-	-	-	-	-	-	25
Bloodworms										
Chironomus	-	-	-	1	2	11	3	-	-	-
Phantom Midges										
Chaoborus	-	-	-	1	-	-	-	-	-	-
Biting Midges										
Bezzia	-	11	-	-	-	-	-	-	-	-
Crane Flies										
Eriocera	4	-	-	-	-	-	-	-	-	-
Dragonflies										
Progomphus	1	*	-	-	-	-	-	-	*	-
Erpetogomphus	1	-	-	-	-	-	-	-	-	-
Somatochlora	-	-	-	-	-	-	-	-	-	-
Damselflies										
Ischnura	1	*	*	-	-	-	-	-	-	*
Soldier Flies	-	-	-	-	-	-	-	-	-	-
Long-Legged Flies	-	-	-	-	-	-	-	-	1	-
Crayfish	*	-	-	-	-	-	-	-	-	-
Nematodes	-	-	2	-	-	-	-	-	-	-
Snails										
Physa	*	-	*	-	-	-	-	-	-	*
Leeches	-	-	-	-	-	-	-	-	-	-
Sludgeworms	*	-	2	8	16	1	19	18	20	1
Total No. per Sq. Ft.	66	101	10	46	41	21	35	30	179	179
Total No. of Kinds	19	7	9	8	6	6	6	5	15	13

* Collected in qualitative samples only.

Table 3
Phytoplankton Data
Wilson Reservoir--Saline River, Kansas
August 3-5, 1970

	Saline River		Wilson Reservoir							Saline River	
Station →	1	4	6	7	9	11	12	13	15	17	18
Depth (feet)	Phytoplankton, cells per ml										
Surface	230	4230	3760	*	1470	2470	2880	1230	820	170	410
5					2180	2290	2470	240	230		
10						2060	2120	1060	620		
15							1350	760	620		
20								590	540		
25								530	590		
	Phytoplankton, wet volume (parts per million)										
Surface	0.1	0.2	2.6	*	1.2	2.3	3.1	1.0	0.2	0.1	0.4
5					3.7	2.1	1.9	0.1	0.1		
10						0.5	0.8	0.7	0.5		
15							1.1	0.4	0.5		
20								0.2	0.7		
25								0.3	2.4		
	Depth of Euphotic Zone (feet)										
				2.0	4.0	10.0	14.4	24.0	25.0		

*No Sample